Polychlorinated Biphenyls

(Non-coplanar PCBs are in this section; coplanar PCBs are in the section titled "Polychlorinated Dibenzo-*p*-dioxins, Polychlorinated Dibenzofurans, and Coplanar Polychlorinated Biphenyls.")

General Information

Polychlorinated biphenyls (PCBs) are a class of chlorinated aromatic hydrocarbon chemicals that once were used as electrical insulating and heat-exchange fluids. Peak production occurred in the early 1970s, and production was banned in the United States after 1979. The continued concern about these chemicals is because of their release into and persistence in the environment.

Food is the main source of exposure for the general population. PCBs enter the food chain by a variety of routes, including migration into food from packaging materials, contamination of animal feeds, and accumulation in the fatty tissues of animals. PCBs are found at higher concentrations in fatty foods. Diets that contain PCB-contaminated fats (e.g., contaminated milk and dairy products, fish, whales) will increase exposure to PCBs. Other sources for the general population include the release of these chemicals from PCB-containing waste sites and fires involving transformers and capacitors. Additionally, the heat from fires can result in the production of dioxins and furans from PCBs (see the section titled "Polychlorinated Dibenzo-*p*-dioxins, Dibenzofurans, and Coplanar Biphenyls"). In certain occupational settings workers can be exposed to PCBs, including the repair or manufacture of transformers, capacitors, and hydraulic systems, and remediation at hazardous waste sites. Both FDA and OSHA have developed criteria on the allowable levels of these chemicals in foods and the workplace. The U.S. EPA has set similar criteria for water and for the storage and removal of waste that contains PCBs.

Exposures to these chemicals usually occur from mixtures rather than from individual PCBs. The different types of PCB chemicals are known as congeners, compounds that are distinguished by the number of chlorine atoms and their location on the biphenyl structure. PCB congeners can be divided into the coplanar, the mono-ortho substituted PCBs, and other PCBs. The significance of this designation is that the coplanar and the mono-ortho-substituted PCBs have similar toxicologic effects as the dioxins. The coplanar PCBs are discussed in the section titled "Polychlorinated Dibenzo-*p*-dioxins, Dibenzofurans, and Coplanar Biphenyls." Table 95 shows the relation between the various PCBs and the arrangements of chlorine atoms and also includes their commonly used abbreviations.

The human health effects of concern include liver disorders (elevated hepatic enzymes), elevated lipids, and gastrointestinal cancers. Reproductive and developmental effects demonstrated in animals may also be of concern. PCBs are classified as probable human carcinogens by IARC and U.S. EPA and are reasonably anticipated to be carcinogens by NTP. Information about external exposure (environmental levels) and health effects is available from the EPA IRIS Web site at http://www.epa.gov/iris and from ATSDR at http://www.atsdr.cdc.gov/toxprofiles.

Interpreting Lipid-Adjusted Serum PCB Levels Reported in the Tables

Lipid-adjusted serum levels of PCBs were measured in a subsample of NHANES participants 12 years and older. Subsamples were randomly selected within the specified age range to be a representative sample of the U.S. population. Measuring these PCBs at these levels is possible because of advances in analytical chemistry. Finding a measurable amount of one or more PCBs in the blood does not indicate that the levels of the PCBs cause an adverse health effect. These data provide physicians with a reference range so that they can determine whether people have been exposed to higher levels of PCBs than those found in the general population. Whether PCBs at the levels reported here are cause for health concern is not known; more research is needed.

Measurement of serum PCBs can reflect either recent or past exposure to PCBs. PCBs with a higher degree of chlorination persist in the body from several months to years after exposure. The contribution of individual PCB congeners to the sum of PCB measurements in the body may vary by exposure source and differences in kinetics. Some of the PCBs measured may represent exposure to the breakdown of other PCBs in a person's environment. Tables 96-117 summarize the results of these measurements. These data will help scientists plan and conduct research about exposure to PCBs and health effects.

Table 95. Polychlorinated biphenyl chemicals (PCBs) and their classification

PCB	CAS number	IUPAC number
Polychlorinated biphenyls (general class)	1336-36-3	
2,4,4'-Trichlorobiphenyl	7012-37-5	PCB 28
2,2',5,5'-Tetrachlorobiphenyl	35693-99-3	PCB 52
2,3',4,4'-Tetrachlorobiphenyl	32598-10-0	PCB 66
2,4,4',5-Tetrachlorobiphenyl	32690-93-0	PCB 74
3,4,4',5-Tetrachlorobiphenyl	70362-50-4	PCB 81
2,2',4,4',5-Pentachlorobiphenyl	38380-01-7	PCB 99
2,2',4,5,5'-Pentachlorobiphenyl	37680-73-2	PCB 101
2,3,3',4,4'-Pentachlorobiphenyl	32598-14-4	PCB 105
2,3',4,4',5-Pentachlorobiphenyl	31508-00-6	PCB 118
3,3',4,4',5-Pentachlorobiphenyl	57465-28-8	PCB 126
2,2',3,3',4,4'-Hexachlorobiphenyl	38380-07-3	PCB 128
2,2',3,4,4',5'-Hexachlorobiphenyl	35065-28-2	PCB 138
2,2',3,4',5,5'-Hexachlorobiphenyl	51908-16-8	PCB 146
2,2',4,4',5,5'-Hexachlorobiphenyl	35065-27-1	PCB 153
2,3,3',4,4',5-Hexachlorobiphenyl	38380-08-4	PCB 156
2,3,3',4,4',5'-Hexachlorobiphenyl	69782-90-7	PCB 157
2,3',4,4',5,5'-Hexachlorobiphenyl	52663-72-6	PCB 167
3,3',4,4',5,5'-Hexachlorobiphenyl	32774-16-6	PCB 169
2,2',3,3',4,4',5-Heptachlorobiphenyl	35065-30-6	PCB 170
2,2',3,3',4,5,5'-Heptachlorobiphenyl	52663-74-8	PCB 172
2,2',3,3',4,5',6'-Heptachlorobiphenyl	52663-70-4	PCB 177
2,2',3,3',5,5',6-Heptachlorobiphenyl	52663-67-9	PCB 178
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	PCB 180
2,2',3,4,4',5',6-Heptachlorobiphenyl	52663-69-1	PCB 183
2,2',3,4',5,5',6-Heptachlorobiphenyl	52663-68-0	PCB 187

Mono-ortho-chlorine-substituted PCBs

Serum levels (expressed per gram of serum lipids) of eight mono-ortho-chlorine-substituted PCBs (PCBs 28, 66, 74, 105, 118, 156, 157, and 167) are reported. Mono-ortho-chlorine-substituted PCBs have been demonstrated to elevate liver enzymes in experimental animals (Parkinson et al., 1983). Like the coplanar PCBs, they have dioxin-like effects and possibly estrogen-receptor interactions. The mono-ortho-chlorine-substituted PCB congeners most frequently detected in general population studies are PCBs 105, 118, and 156. Of these, PCB 118 was the most commonly detected (47%) in the NHANES 1999-2000 subsample. The frequency of detection for the eight mono-ortho-chlorine-substituted PCBs ranged from 2% to 47%. In pooled (100 g) samples of serum collected from a convenience sample (240 donors) from the U.S. general population in 1988, the mean level of PCB 118 was 79 ng/gram of lipid (Patterson et al., 1994). In this NHANES 1999-2000 subsample, the 75th percentile level for PCB 118 was 13.1 ng/gram of lipid, a finding consistent with decreasing levels of the mono-ortho-chlorine-substituted PCBs over these years. In a convenience sample obtained from the general Canadian population in 1994, the PCB 118 level at the 50th percentile was 17.2 ng/gram of lipid (Longnecker et al., 2000). In a convenience sample of the Swedish general population, the median level for PCB 118 was 37.5 ng/gram of lipid (Glynn et al., 2000). The higher PCB 118 level (and other PCBs) in that study may be from heavy fish consumption, which can contribute to about a twofold increase in the level of PCB 118 (Patterson et al., 1994).

The PCB 156 levels in the NHANES 1999-2000 sub-sample are similar to those measured in the Canadian study (Longnecker et al., 2000), but lower than levels in the Swedish study (Glynn et al., 2000).

Di-ortho-chlorine-substituted PCBs

Serum (lipid-adjusted) levels are reported for 14 di-ortho-chlorine-substituted PCBs. The most frequently detected di-ortho-chlorine-substituted PCBs in general populations are 138, 153, and 180 (Patterson et al., 1994). These congeners also were found to contribute about 80% of the total PCB concentration in the Swedish general population (Glynn et al., 2000). Because of its predominance, PCB 153 has been used as a marker of exposure for the other PCBs. In 1994, levels of PCBs 138, 153, and 180 in pooled, banked serum were generally three to four times lower than levels reported in 1988 (Longnecker et al., 2000; Patterson et al., 1994). The concentrations of the di-ortho-substituted PCBs are generally higher than the mono-ortho-substituted PCBs, which are higher than the coplanar PCBs (Glynn et al., 2000; Longnecker et al., 2000; Patterson et al., 1994). Heavy fish consumption can also contribute to about a twofold increase in the concentration of these PCB congeners (Patterson et al., 1994).

Tri-ortho-chlorine-substituted PCBs

The tri-ortho-chlorine-substituted PCBs are 177, 178, 183, and 187. The levels for PCB 187 shown in this *Report* are similar to the levels meaured in a convenience sample of the general Canadian population in 1994 (Longnecker et al., 2000).

Table 96. PCB 28 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1849
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	647
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1202
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	886
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	963
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	618
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	392
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	687

< LOD means less than the limit of detection, which averaged 16.7 ng/g of lipid (SD 5.3, maximum value 32.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 97. PCB 52 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1912
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	664
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1248
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	908
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1004
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	631
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	408
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	716

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 98. PCB 66 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1931
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	671
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1260
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	919
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1012
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	636
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	414
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	723

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 99. PCB 74 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	20.7 (17.5-23.6)	29.0 (24.5-32.3)	1924
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	671
20 years and older	*	< LOD	< LOD	< LOD	12.6 (<LOD-14.4)	22.3 (19.5-25.6)	30.0 (25.6-35.9)	1253
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	15.3 (12.8-17.8)	21.5 (18.1-24.7)	915
Females	*	< LOD	< LOD	< LOD	13.9 (<LOD-16.1)	24.5 (21.7-28.7)	31.6 (28.8-40.3)	1009
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	15.8 (12.9-18.0)	636
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	29.0 (19.8-37.1)	43.5 (34.5-65.7)	411
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	21.6 (19.1-24.0)	29.0 (24.3-31.9)	719

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 100. PCB 99 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	13.1 (<LOD-14.7)	19.1 (15.6-21.4)	1897
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	654
20 years and older	*	< LOD	< LOD	< LOD	< LOD	13.9 (<LOD-16.2)	19.9 (16.1-23.5)	1243
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	16.7 (13.8-20.5)	905
Females	*	< LOD	< LOD	< LOD	< LOD	13.9 (<LOD-16.0)	20.0 (16.0-25.0)	992
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	624
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	20.3 (17.0-31.1)	31.5 (21.4-66.0)	400
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	12.5 (<LOD-14.7)	18.1 (14.3-20.8)	715

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 101. PCB 101 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1929
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	669
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1260
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	918
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1011
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	634
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	413
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	724

< LOD means less than the limit of detection, which averaged 13.2 ng/g of lipid (SD 4.2, maximum value 25.7).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 102. PCB 105 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1915
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	665
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1250
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	913
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1002
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	635
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	12.8 (<LOD-18.0)	409
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	714

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 103. PCB 118 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	13.1 (<LOD-15.1)	27.0 (22.1-30.9)	40.3 (32.0-48.6)	1926
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	667
20 years and older	*	< LOD	< LOD	< LOD	14.7 (12.9-17.2)	28.0 (24.4-33.5)	43.6 (34.5-53.3)	1259
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	19.6 (16.5-24.4)	28.0 (23.4-38.3)	919
Females	*	< LOD	< LOD	< LOD	16.7 (14.1-18.8)	32.0 (27.5-40.3)	46.8 (40.3-57.8)	1007
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	17.0 (14.1-18.3)	23.7 (20.9-27.1)	636
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	18.9 (12.8-24.2)	38.6 (28.4-53.2)	59.7 (44.1-84.4)	413
Non-Hispanic whites	*	< LOD	< LOD	< LOD	13.1 (<LOD-16.3)	25.6 (20.7-32.0)	40.3 (29.1-47.9)	720

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 104. PCB 128 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1927
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	668
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1259
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	917
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1010
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	636
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	409
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	725

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 105. PCB 138 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	49.2 (42.3-57.3)	70.8 (59.3-83.7)	1930
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	669
20 years and older	*	< LOD	< LOD	< LOD	< LOD	54.7 (46.0-62.3)	72.8 (65.3-90.5)	1261
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	47.2 (<LOD-59.0)	68.2 (54.5-88.3)	918
Females	*	< LOD	< LOD	< LOD	< LOD	52.8 (45.0-61.1)	72.0 (61.2-85.6)	1012
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	636
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	72.1 (61.7-97.8)	122 (83.6-200)	412
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	49.3 (<LOD-56.0)	70.1 (55.7-85.2)	727

< LOD means less than the limit of detection, which averaged 21.1 ng/g of lipid (SD 6.7, maximum value 41.1).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 106. PCB 146 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	13.3 (<LOD-15.7)	1923
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	667
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	14.2 (<LOD-17.1)	1256
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	915
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	13.4 (<LOD-16.2)	1008
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	633
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	16.9 (13.5-22.4)	28.1 (17.6-44.3)	412
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	723

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.4).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 107. PCB 153 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	77.8 (67.9-88.8)	112 (93.0-128)	1926
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	668
20 years and older	*	< LOD	< LOD	< LOD	< LOD	83.2 (72.8-97.0)	122 (98.9-139)	1258
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	75.0 (64.2-89.0)	111 (83.9-137)	917
Females	*	< LOD	< LOD	< LOD	< LOD	79.0 (69.2-93.0)	118 (93.0-139)	1009
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	67.5 (56.8-76.0)	634
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	59.1 (<LOD-82.6)	121 (101-146)	176 (125-299)	412
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	76.4 (67.2-87.3)	102 (86.2-128)	725

< LOD means less than the limit of detection, which averaged 28.6 ng/g of lipid (SD 9.0, maximum value 55.6).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 108. PCB 156 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	12.5 (<LOD-14.6)	16.5 (14.9-18.7)	1907
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	665
20 years and older	*	< LOD	< LOD	< LOD	< LOD	13.5 (<LOD-15.8)	17.5 (15.8-20.1)	1242
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	12.6 (<LOD-14.6)	16.0 (13.8-18.7)	912
Females	*	< LOD	< LOD	< LOD	< LOD	12.8 (<LOD-15.8)	16.3 (14.2-21.3)	995
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	631
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	14.6 (<LOD-18.6)	21.6 (16.0-33.0)	412
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	13.6 (<LOD-15.8)	17.4 (15.8-19.8)	711

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 109. PCB 157 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1897
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	654
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1243
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	901
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	996
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	622
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	405
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	716

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 110. PCB 167 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1908
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	666
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1242
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	908
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1000
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	627
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	411
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	715

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 111. PCB 170 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	23.6 (21.6-25.8)	30.9 (26.5-36.6)	1798
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	645
20 years and older	*	< LOD	< LOD	< LOD	< LOD	24.9 (22.4-27.2)	33.9 (28.2-38.3)	1153
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	23.8 (22.0-26.3)	32.6 (27.2-41.9)	863
Females	*	< LOD	< LOD	< LOD	< LOD	22.4 (19.1-25.8)	29.7 (25.6-37.3)	935
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	23.2 (20.2-26.6)	606
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	30.9 (21.0-36.9)	39.6 (33.4-60.6)	382
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	24.0 (21.9-26.1)	31.0 (26.5-37.5)	658

< LOD means less than the limit of detection, which averaged 8.9 ng/g of lipid (SD 2.8, maximum value 17.2).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 112. PCB 172 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1901
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	660
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1241
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	911
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	990
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	630
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	409
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	706

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

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Table 113. PCB 177 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1873
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	653
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1220
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	887
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	986
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	622
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	399
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	698

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

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Table 114. PCB 178 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1932
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	669
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1263
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	919
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1013
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	635
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	415
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	724

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.4).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 115. PCB 180 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	37.4 (33.6-41.0)	62.0 (55.8-68.2)	79.0 (70.8-91.7)	1924
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	667
20 years and older	*	< LOD	< LOD	< LOD	41.0 (37.6-45.2)	65.5 (58.6-71.2)	83.8 (75.6-96.3)	1257
Gender								
Males	*	< LOD	< LOD	< LOD	40.5 (34.8-44.7)	65.1 (58.6-71.4)	83.8 (72.6-97.0)	919
Females	*	< LOD	< LOD	< LOD	34.4 (30.9-38.6)	56.7 (50.9-66.6)	74.6 (66.7-85.9)	1005
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	41.7 (33.2-50.5)	56.6 (48.0-65.0)	633
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	39.1 (32.4-48.2)	78.4 (63.1-102)	117 (89.4-160)	414
Non-Hispanic whites	*	< LOD	< LOD	< LOD	39.9 (35.9-45.0)	62.0 (56.2-68.8)	79.0 (69.5-91.9)	719

< LOD means less than the limit of detection, which averaged 14.5 ng/g of lipid (SD 4.6, maximum value 28.2).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 116. PCB 183 (lipid adjusted)

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1928
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	668
20 years and older	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1260
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	919
Females	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	1009
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	635
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	413
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	722

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.5).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.

Table 117. PCB 187

Geometric mean and selected percentiles of serum concentrations (nanograms/gram [ng/g] of lipid or parts-per-billion on a lipid weight basis) for the U.S. population aged 12 years and older, National Health and Nutrition Examination Survey, 1999-2000.

	Geometric mean (95% conf. Interval)	Selected percentiles (95% confidence interval)						Sample size
		10th	25th	50th	75th	90th	95th	
Total, age 12 and older	*	< LOD	< LOD	< LOD	< LOD	17.7 (16.3-19.3)	24.6 (22.0-27.6)	1930
Age group								
12-19 years	*	< LOD	< LOD	< LOD	< LOD	< LOD	< LOD	667
20 years and older	*	< LOD	< LOD	< LOD	< LOD	19.2 (17.0-21.5)	25.9 (24.1-29.4)	1263
Gender								
Males	*	< LOD	< LOD	< LOD	< LOD	17.7 (15.8-19.5)	25.9 (19.7-30.2)	917
Females	*	< LOD	< LOD	< LOD	< LOD	17.7 (15.7-20.4)	24.2 (21.8-26.4)	1013
Race/ethnicity								
Mexican Americans	*	< LOD	< LOD	< LOD	< LOD	< LOD	17.3 (15.1-19.1)	636
Non-Hispanic blacks	*	< LOD	< LOD	< LOD	15.3 (<LOD-21.1)	31.1 (26.0-39.0)	47.1 (35.6-76.4)	412
Non-Hispanic whites	*	< LOD	< LOD	< LOD	< LOD	16.8 (14.9-18.6)	22.0 (19.3-24.3)	727

< LOD means less than the limit of detection, which averaged 6.4 ng/g of lipid (SD 2.0, maximum value 12.4).

* Not calculated. Proportion of results below limit of detection was too high to provide a valid result.